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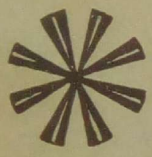

STRUCTURE OF ROMANO-BRITISH POTTERY KILNS

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THE STRUCTURE OF ROMANO-BRITISH POTTERY KILNS

By PHILIP CORDER

Except on Hadrian's Wall, where building inscriptions may still be expected, the dating of Roman sites in Britain normally depends on coins and stratified pottery. On permanent military sites and, to a lesser extent, in the larger towns, decorated Samian occurs in sufficient quantity to provide a reliable basis for chronology[1]. But on occupation sites of a humbler nature such as the small walled towns, now known to have been numerous, or the many small country villas, a knowledge of which is essential to the proper understanding of the economic history of the province, the only stratified evidence that can be recovered in sufficient quantity is coarse pottery. It is therefore of the first importance to be able to date Romano-British coarse pottery as closely as possible.

The main outlines of the chronology of Samian ware may now be said to be firmly established, thanks to the detailed studies of western European scholars. It can by no means yet be claimed that our knowledge of coarse pottery is as securely based. There are two main reasons for this: first, coarse pottery was produced in a vastly greater variety of forms than those used by the Samian potters, whose use of moulds enabled their products to be stereotyped and mass-produced; second, since special clay was required for its manufacture, the production of Samian ware was confined to south, central and eastern Gaul, and was never successfully established in Britain. Moreover, Samian ware was to a large extent a luxury product, common in the military mess and on the tables of the well-to-do, while coarse ware served the daily needs of all classes of the community, and was therefore produced in much greater quantity. So great was the demand that after the early years of the Conquest manufacture took place wherever suitable clay was to be found. While certain centres of manufacture can be recognized, particularly in the later periods of the occupation, where a regular industry served a wider market than its immediate neighbourhood, it is evident that each little town and every upland farm tended to supply its everyday needs from local sources.

Up to the Hadrianic-Antonine period certain classes of vessel, e.g., mortaria, continued to be bought from abroad, but thereafter the volume of imports from the Continent declined and, during the third century and after, the bulk of the domestic pottery in everyday use was produced at local kilns.

How are we to date coarse pottery? In the first place by its occurrence in stratified deposits with such securely dated objects as inscriptions and coins. But this by itself cannot form a secure basis, and in using it the nature of the deposit must always be taken into account. The survival in use of coarse pottery is probably much less than that of luxury wares such as decorated Samian, but that earthenware vessels do survive long after their date of manufacture is evident. Much more important is rubbish survival in such structures as earthworks or long occupied sites, where the earth is full of broken sherds from earlier occupations.

[1] In the use of decorated Samian allowance must always be made for a high survival rate. *cf.* Hawkes and Hull, *Camulodunum*, 174–80.

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The second method of dating is by association with vessels, e.g., Samian ware, which have already been dated elsewhere. The possibility of survival is here as important, particularly in grave groups, for it appears that a vessel outdated in daily use may still have been chosen for funerary deposit.

On many sites, however, inscriptions and coins may be absent, and Samian, if not absent, too scarce to be relied upon as a criterion of date. It has been usual in such an event to fall back on typology, and to cite parallels for the forms of vessels from another part of the province. While it is undeniable that there were fashions in the shapes of vessels, as there are to-day, and that therefore a typological series might be built up by scrupulous reliance upon site-evidence, it should be recognized that only approximate dating can be achieved by typology, which has sometimes proved very misleading. Where, however, it is possible to assign pots to *the source* of their manufacture, and to date *the kilns* where they are made, either by associated coins, or by the occurrence of their products in dated stratified deposits, much greater precision can be hoped for. The debris found in or near kilns normally consists of 'wasters' rendered unsaleable during manufacture. Since the life of any kiln is very short, the chance of survival of sherds on a pottery site is much less than that on an occupation site. The discovery of pottery kilns and a detailed study of their products is thus of prime importance, not merely for the light it may throw on one of the major industries of the province, but as the only means whereby many sites are to be dated at all.

Our knowledge of Roman coarse pottery has notably increased in the last thirty or forty years, but much information has still to be accumulated before a *corpus* of pottery types can safely be compiled. *The Map of Roman Britain* (O.S. 3rd Edn., 1956) lists 85 pottery kilns, apart from some 20 potteries. That there are many more to be discovered is certain, for such small and temporary structures are easily overlooked and very many must have been destroyed unrecorded. There is no more urgent task facing students of Roman Britain than the discovery of pottery kilns and the classification and publication of their products, and their distribution.

This paper deals with the structure of Romano-British kilns rather than with products or distribution. Though it is obviously impossible to consider structures without enquiring as to their function, it is not proposed to explore in any detail the process of manufacture of pottery, since others, better qualified, are at work on this important subject.

An examination of the copious and scattered literature dealing with Roman kilns makes it evident that few have been either scientifically examined or carefully recorded until quite recently. The following classification of their bewildering variety of structural detail should provide the future excavator with a knowledge of what to look for, and how to interpret some of the bits and pieces with which he will be confronted. Until many more kilns have been better excavated there is little hope of achieving the authoritative *corpus* of Romano-British coarse pottery, which, when it is compiled, should reduce the presentation of pottery evidence to the neat tabulation now normal in a numismatic report.

Only one legionary pottery and tilery has been discovered in Britain, that of the Twentieth Legion at Holt in Denbighshire. This establishment, which included, besides

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a battery of kilns (fig. 1), the workmen's barracks, a bath building and the manager's house, was published by Professor W. F. Grimes in 1930[1]. This report contained also the only general study so far devoted to Roman pottery kilns[2], together with a classification and an annotated list of known kilns. All future discussion of the subject must be indebted to this classic work, which should be familiar to every excavator of a pottery kiln. Since it was written, however, a number of kilns have been discovered that exhibit structural features not known, or recognized, in 1930. Though Professor Grimes's classification requires little modification, certain additions now need to be made to it.

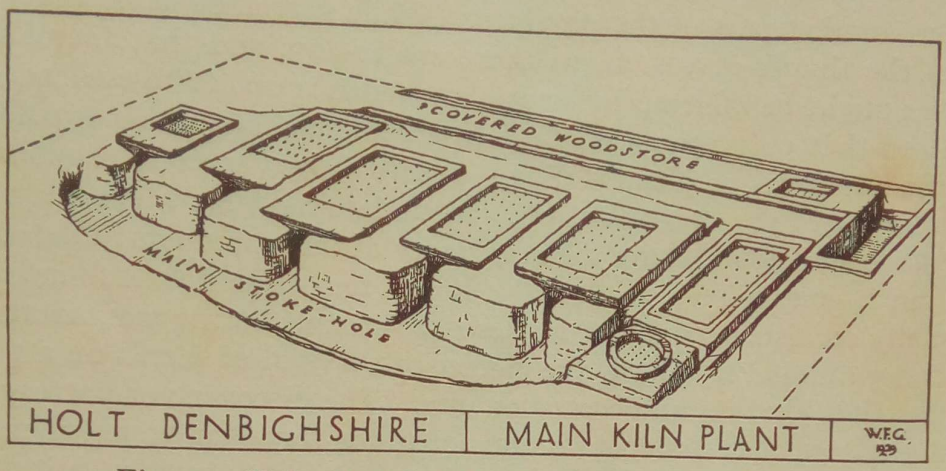

Fig. 1. Holt, Denbighshire. The main kiln plant

It is not necessary here to describe any of the kilns of the Holt establishment, for there is nothing to add to Professor Grimes's definitive account. This paper is concerned rather with the innumerable little local kilns that produced the bulk of the pots that were in daily use among the civil population of the province. But the picture would be incomplete without reference to the rare solidly-built permanent kilns that have occasionally been found (as, for example, at Colchester in 1877) that belong to the same class as the Holt kilns. One of these, found in 1879 at Philips Norton, Wellow, 6 miles south of Bath, has recently been brought to my notice through the kindness of Mr. Frank Jenkins, F.S.A. The kiln is described by Mr. Richard Mann in a letter to the *Bath Evening Chronicle* of 18th July, 1879, and an admirable drawing (Pl. IIA) has survived by some happy chance in the Herne Bay Public Library, whence Mr. Jenkins rescued it. A flag-paved stokehole led into a rectangular chamber, 2 ft. 3 ins. wide and 3 ft. 3 ins. long, the sides of which sloped outwards for some 18 ins. This was spanned by four stout arches of masonry 5 to 6 ins. wide, spaced at varying intervals of 1 foot, and 8 to 9 ins. viewed from the stokehole end. Above the level surface of these bars was the circular oven, 3 ft. 9 ins. in diameter, its walls, again sloping outwards, standing when found nearly a foot high. The oven floor, a considerable part of which survived, was formed of a series of small stone firebars, 10 ins. long, 2 ins. wide and $3\frac{3}{4}$ ins. deep, arranged in rows at right-angles to the main cross-bars, and having their ends let into slots cut in the edges of these. The drawing shows eleven of them in position in the section farthest from the flue, and the slots for the ends of thirteen remained in the next cross-bar. One other structural feature is shown in the drawing, an opening in the oven wall, 6 ins. above the floor, that must have served as a chimney. When excavated it was blocked by a large stone, indicating its deliberate closing once the required draught had been obtained through the kiln. No evidence as to the date of this kiln is recorded, but its close general similarity to the Holt and Colchester kilns leaves no doubt of its Roman date. Its unusual solidarity is no doubt related to the fact that here coal was used as fuel.

[1] *Y Cymmrodor*, XLI. [2] *Ibid.*, 53–85.

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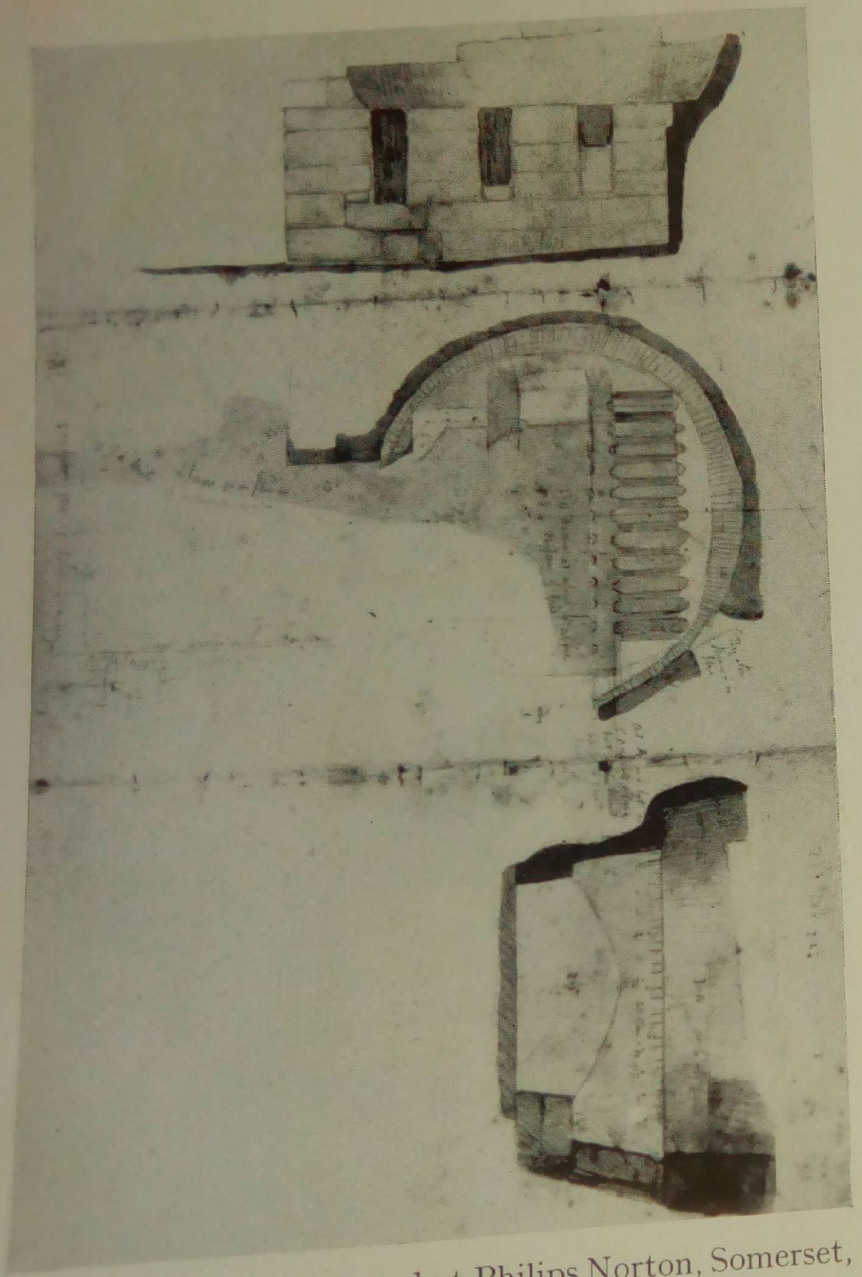
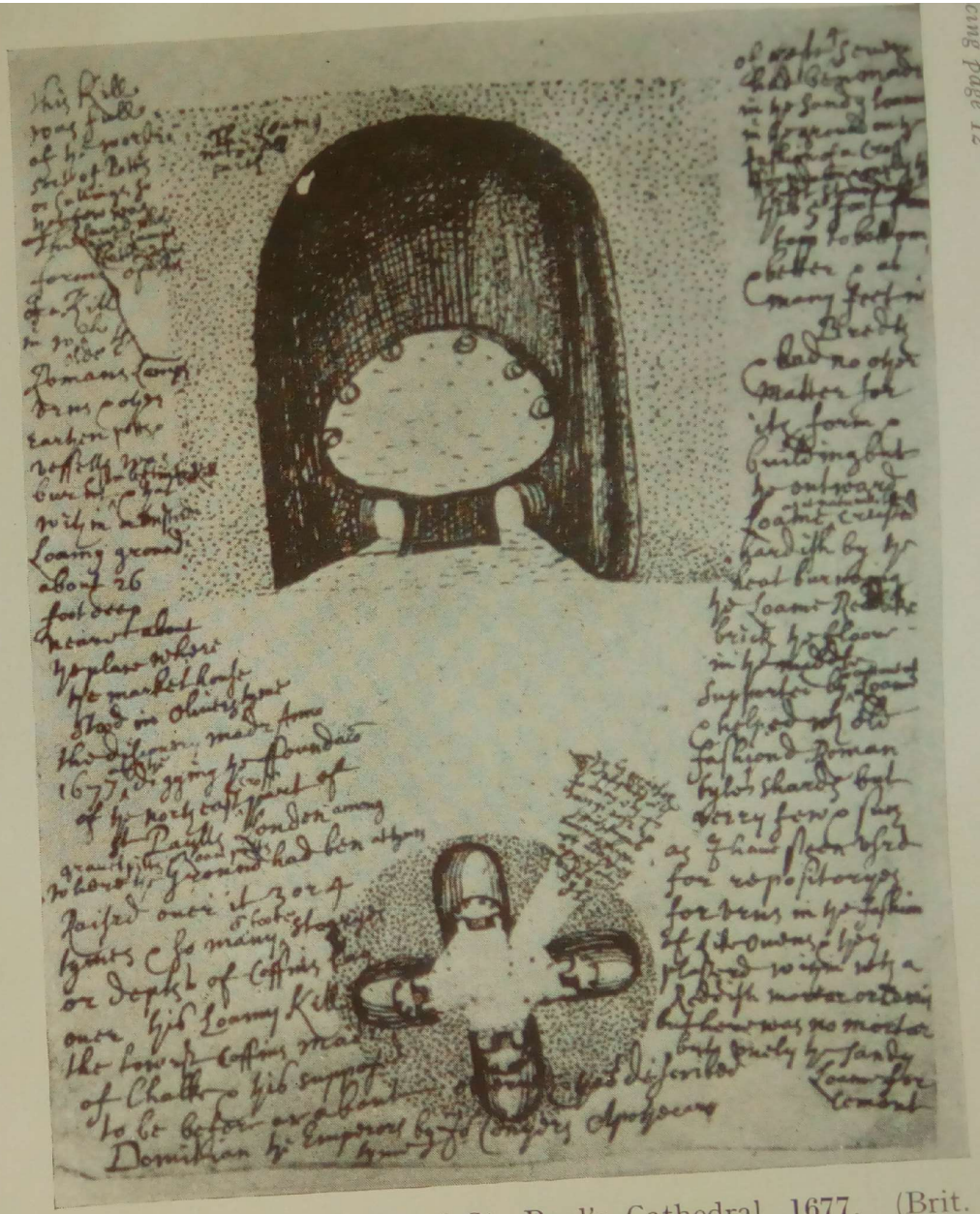


A. Drawing of kiln found at Philips Norton, Somerset, in 1879



B. Kilns found on site of St. Paul's Cathedral, 1677. (Brit. Mus., Sloane MSS. 958, f. 105)

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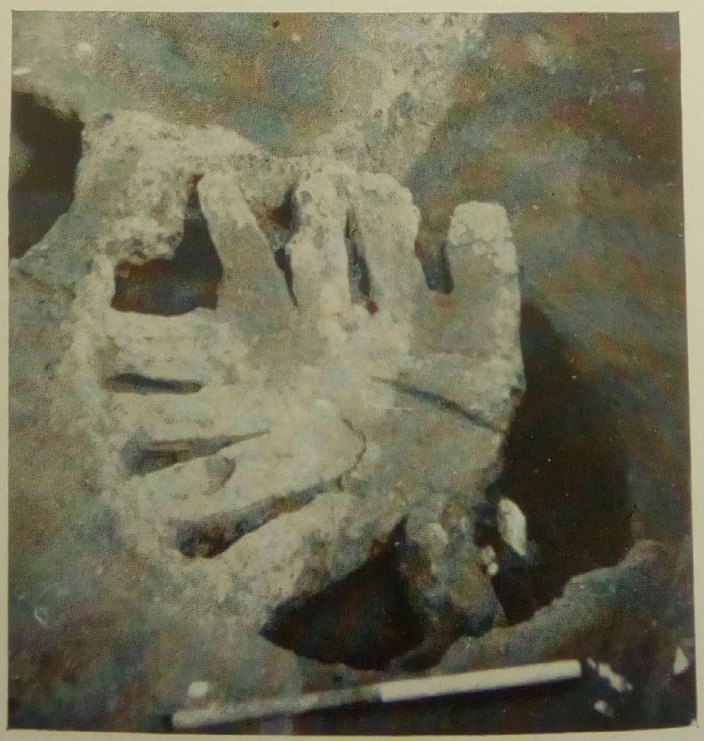
A. Kiln at Winterton, Lincs.
(*By courtesy of Mr. H. Dudley, F.S.A.*)



B. Firebars at Canterbury, Whitehall Road kiln
(*By courtesy of Mr. F. Jenkins, F.S.A.*)

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Apart from the Holt establishment, and such rare structures as that just described, the local kilns that are the subject of this paper are small rather makeshift affairs. Only two main types are known in Britain:

I. Updraught kilns

II. Horizontal draught kilns.

The former are by far the commoner. There is no evidence of Roman pottery having been fired in clamps, like tiles. These two types are dealt with separately.

I. UPDRAUGHT KILNS (fig. 2)

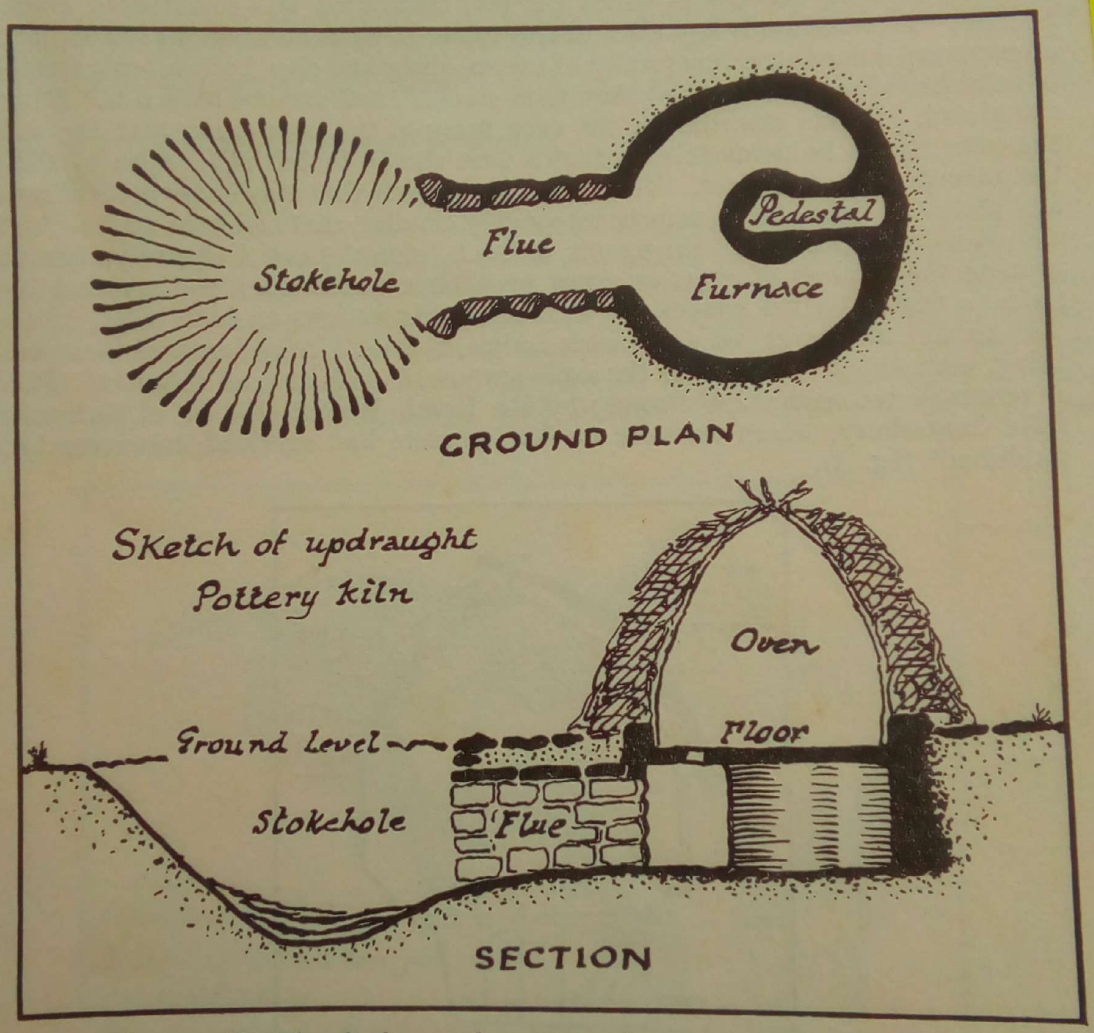

Fig. 2. Sketch of plan and section of a typical updraught kiln

The essential parts of an updraught kiln are:

1. *Stokehole pit.* A large hollow dug below ground level in which the fire was started, and into which the ash could be raked.
2. *A flue or fire-tunnel*, normally not more than 18 ins. or 2 ft. in width and often much less, leading from the stokehole to the furnace. This was walled in any material available—tiles, stones or clay. It was frequently roofed with slabs of stone or tiles, or its sides were corbelled out, or both. It varied greatly in length in different kilns, but was seldom longer than 5 or 6 ft., and often very much shorter.
3. *The furnace or combustion-chamber*, beneath the oven in which the pots were to be fired. This was normally a circular, oval or sub-rectangular hole 2 to 3 ft. deep dug

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below ground level, the walls of which had been plastered with clay to a thickness of several inches. After the first firing this would become hard, enabling the furnace to be used again and again until a new kiln became necessary. In some kilns the furnace walls formed a series of bulges or pilasters[1] that sometimes, but not always, served a structural purpose, but certainly increased the turbulence of the hot gases. The furnace walls were seldom carried up more than a few inches above ground level, and often were levelled and flattened at this point to carry the ends of a series of fire-bars, in those kilns where these were used to form the oven floor on which the pots were stacked for firing.

The oven or firing chamber in which the pots were fired was constructed above the furnace. Very seldom is any trace of this found in an excavation, as it was normally a temporary domed structure formed of turves, straw and clay, built up on a framework of branches around the pots as they were stacked, and removed when the firing was completed. It was essential for the even firing of the pots either that the walls of the oven should be permeable, or that a vent should be left at its apex to allow for the passage of the hot gases. The only evidence of it that may occur in an excavation are 'plates' or slabs of clay, sometimes roughly circular, that had been used to reinforce the oven wall (Pl. VE). Fragments of such 'plates' have frequently been found bearing the impress of grass or straw on their concave sides and smeared by the potter's fingers on the convex, or with straw impressions on both sides. But it is also certain that large 'wasters', such as lids, that had been damaged in a previous firing, were sometimes used for the same purpose, as in Kiln I at Silchester[2] (Pl. VIA). A tentative reconstruction drawing by Mr. Frank Jenkins, F.S.A., of such an oven from Canterbury, where evidence for its structure had survived, has recently been published[3] (fig. 3).

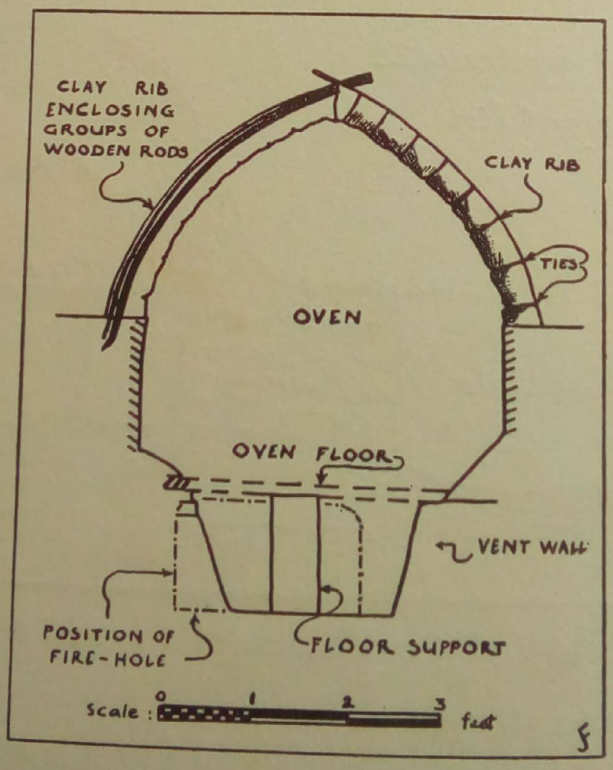

Fig. 3. Canterbury. Reconstruction showing method employed in making oven roof

All updraught kilns of whatever shape consisted of these four parts: stokehole, flue, furnace and temporary oven. In their construction the main problem was to provide

[1] E.g., Black Heath Meadow, v. Heywood Sumner, *Excavations in New Forest Roman Pottery Sites*, 76 and Pl. XXIII, and Shepton Mallet, v. *V.C.H. Somerset*, I, 318 and *Proc. Som. Arch. & N.H. Soc.*, vol. XIII.

[2] *Arch.*, LXII (1910), 328.

[3] *Antiq. Journ.*, XXXVI (1956), 52.

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a stable oven floor, evenly permeable to heat, while allowing as much freedom as possible for removing soot and ash from the furnace between firings. This problem was solved in a great variety of ways, many of them of a somewhat makeshift character.

Oven floors are of three main types:

A. Permanent clay floors pierced by holes or vents, forming an integral part of the kiln structure.

B. Temporary floors either of fire-bars or tiles that were removable between firings.

C. Temporary floors without either fire-bars or other prefabricated furniture, formed from unfired pots or wasters.

At the risk of some repetition the types of supports used for these may be treated separately.

A. PERMANENT VENT-HOLED FLOORS

I. *Without support*

This type of floor is only found in small kilns less than about 3 ft. 6 ins. in diameter, such as those at Crambeck (fig. 4)[1], as the construction of a flat floor in clay sufficiently strong to bear the weight of the pots stacked upon it was too difficult in larger kilns. Such a floor had a series of irregular holes through it for the passage of the hot gases, made by the potter's fingers while the clay was still plastic before firing. It must be supposed that it was erected in the first place upon a timber frame which would be burnt during the first firing, thus converting the floor into a permanent structure.

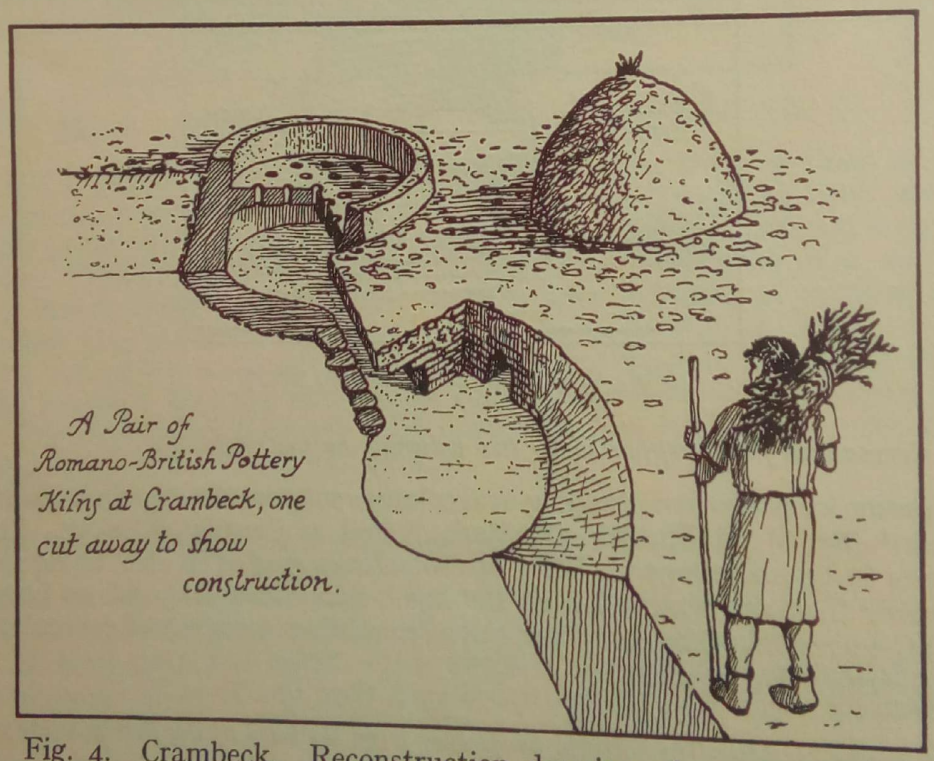

Fig. 4. Crambeck. Reconstruction drawing of a pair of kilns

This type of oven floor had the very great advantage over almost all others of allowing the heat to penetrate evenly over its whole area unimpeded by any solid pillar or buttress in the furnace beneath. The clearing of soot and ash from the flue and furnace between the firings could be easily accomplished by raking it back into the stokehole.

[1] Corder, *The Roman Pottery at Crambeck, Castle Howard* (1928), fig. 16.

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A local variant of this type is found in the New Forest, e.g., Sloden Enclosure[1], where the floor of the furnace is stepped up in the middle opposite the flue. As in other New Forest kilns a separate chimney leading directly out of the furnace seems to have been employed. Such chimneys are, however, uncommon features in Romano-British kilns elsewhere, for they must have been closed as soon as the required draught had been obtained.

II. *A central pillar in the form of an inverted cone*

As the base of the cone forms the central part of the oven floor, the vents in this can only be provided around its perimeter, as at Shoebury (Essex)[2] (fig. 5). Such an arrangement can have been seldom used, as the central cone filled so large a part of the furnace, preventing heat from being evenly distributed throughout the oven. The removal of ash from the furnace must also have been extremely difficult. At Old Sloden[3], in the New Forest only four ventholes appear to have been provided in the oven floor.

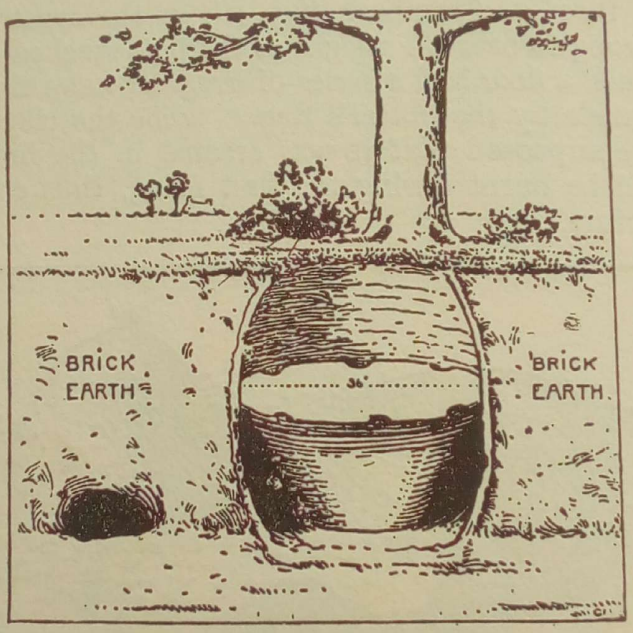

Fig. 5. Shoebury, Essex, 1895

III. *Permanent floor supported by two columns or pedestals*

In some kilns two free-standing oval columns support the clay floor, as at Needham (Norfolk)[4] (fig. 6), at Throlam (E. Yorks.)[5] and at Cantley, Kiln 3[6]. This enables the vents to be made larger. They are sometimes graded in size, being made larger the farther they are removed from the flue. Sometimes they are so large that the floor of the oven might be best described as consisting of a series of permanent fire-bars like the arms of a starfish.

IV. *A central tongue-like column projecting from the back of the furnace opposite the flue*

This is perhaps the commonest types of support, whether the oven floor is a permanent structure or composed of prefabricated fire-bars (*v. infra*). At Dorchester (Oxon)[7] (fig. 7) the floor is pierced by holes about 4 ins. in diameter, as also at Caistor,

[1] Sumner, *op. cit.*, Pls. XV, XVI.
[2] *P.S.A.*, 2nd series, XVI (1895), 40.
[3] Sumner, *op. cit.*, Pl. XIII.
[4] *Norfolk Arch.*, XXVIII, 211, fig. 10.
[5] Corder, *The Roman Pottery at Throlam, Holme-on-Spalding Moor* (1930), figs. 6 and 8.
[6] *Y.A.J.*, XXXIII (1955), 404 ff.
[7] *Oxoniensia*, I (1936), fig. 14.

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Kiln III[1], while at Caistor, Kiln II, nearby, there are six holes each side of the support of irregular elongated oval shape, decreasing in size with their distance from the flue. This form of support was also normal in the rare rectangular or sub-rectangular kilns[2]. In these the floor is either formed of, or supported on, rough arches of clay, brick, or tile spanning the space between the support and the walls, as at Colchester,

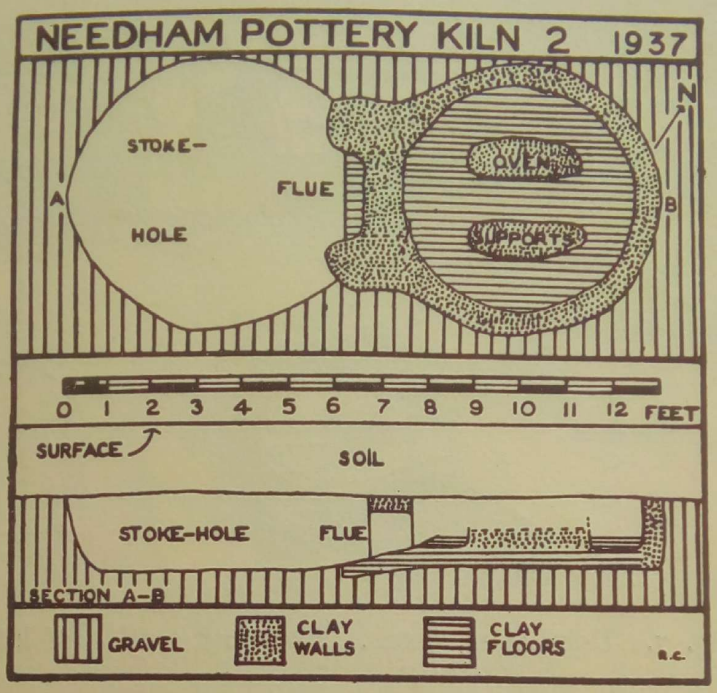

Fig. 6. Needham, Norfolk. Plan and section of Kiln II

Kiln XXIV (1946). There are usually not more than three of these on each side of the central support. At Stibbington, Kiln I (1957)[3], oblique holes pass through the body of the central column itself, an arrangement that I have not seen paralleled elsewhere. While this paper was in the press, the excavation of a well-preserved kiln at Water Newton (Northants.) has provided evidence of another method of supporting the vent-holed oven floor upon a central pedestal of this type. From the pedestal radiated a series of permanent fire-bars that had been made by inserting straight branches into the sides of the combustion-chamber and coating them with clay. The vent-holed floor was then constructed on top of these, the holes being spaced so as to fall between the bars.[4]

B. *TEMPORARY FLOORS OF FIRE-BARS OR TILES*

In nearly all other types of kiln the oven floor was re-erected for each firing, and consisted of fire-bars of various forms. Whether of clay or tile these were prefabricated and could be used again and again. This explains the fact that many kilns have been found that show no trace of any oven floor or its supports, for these supports also were often removable (p. 19).

Whatever form of fire-bar was employed, a support in the centre of the furnace was required, as the fire-bars were normally disposed radially like the spokes of a wheel.

[1] *J.R.S.*, XXII (1932), fig. 4 and Pl VI.
[2] Hevingham, Norfolk (1954). Information kindly supplied by Mr. R. R. Clarke, F.S.A.
[3] Information kindly supplied by Mr. B. R. Hartley, F.S.A.
[4] Information kindly supplied in advance of publication by the excavators, Messrs. Webster, Gillam and Hartley, F.F.S.A.

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Central supports were of such widely different forms that a complete classification is impracticable. The following types have been found:

(*a*) *A projecting tongue-like column* extending from the back of the furnace opposite the flue entrance like that just described (p. 16). Such a support occurred at Sibson (fig. 8)[1].

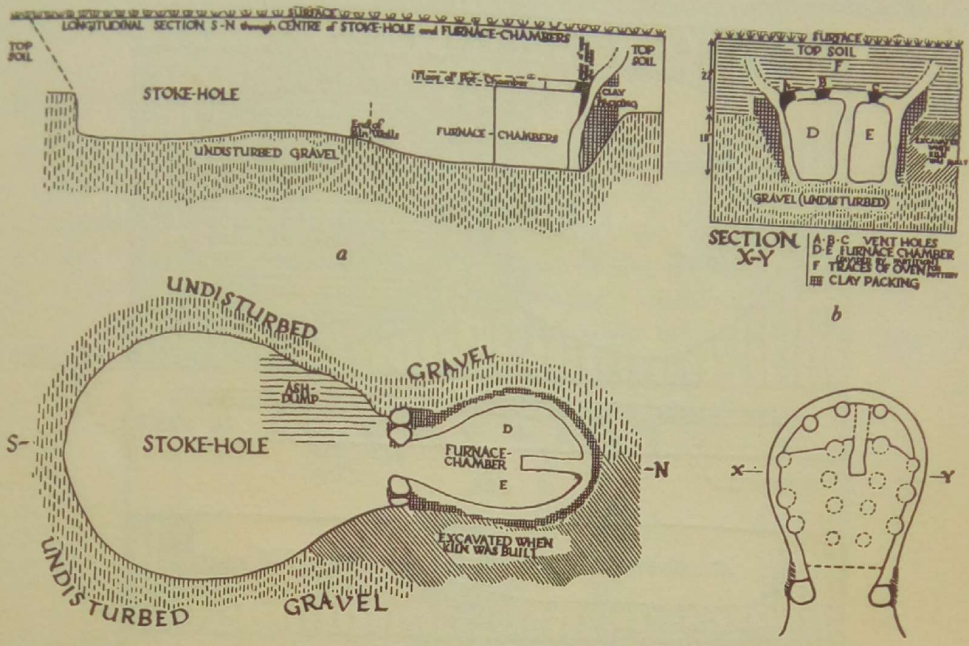

Fig. 7. Dorchester, Oxon. Plan and section of kiln

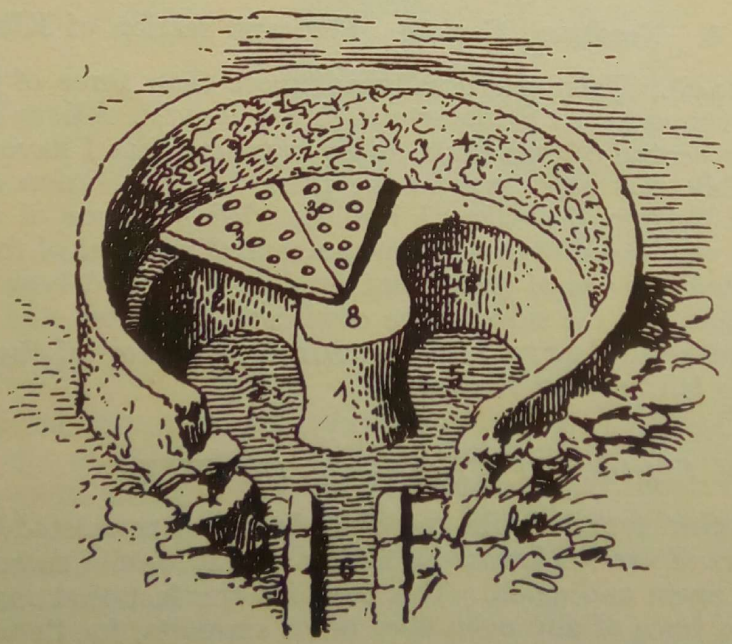

Fig. 8. Sibson, Northants, 1844. Plan of kiln

(*b*) *A permanent central column*, often shaped like a bollard, flattened on top.

(*c*) *A temporary column built up anew for each firing* of the kiln, and not, as (*a*) and (*b*), forming a permanent part of the kiln structure, though, if composed of several elements, these were often smeared or luted with clay.

[1] *J.B.A.A.* II (1847), 164.

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The following types have been recorded:

(i) *A large stone or column of stones*, as at Weston Favell (fig. 9)[1].

(ii) *Roughly-fashioned bricks or blocks of clay*, as at Norton (E. Yorks).[2]

(iii) *A single 'bollard' of clay*, as at Earl Shilton[3] (Pl. Vc).

(iv) *Large inverted jars*, as at Norton[4], Milton (Wilts)[5], and Upper Sheringham (Norfolk)[6].

(v) Other prefabricated cylinders of clay, as at the Lincoln Racecourse Kiln (Pl. VIb and fig. 11)[7].

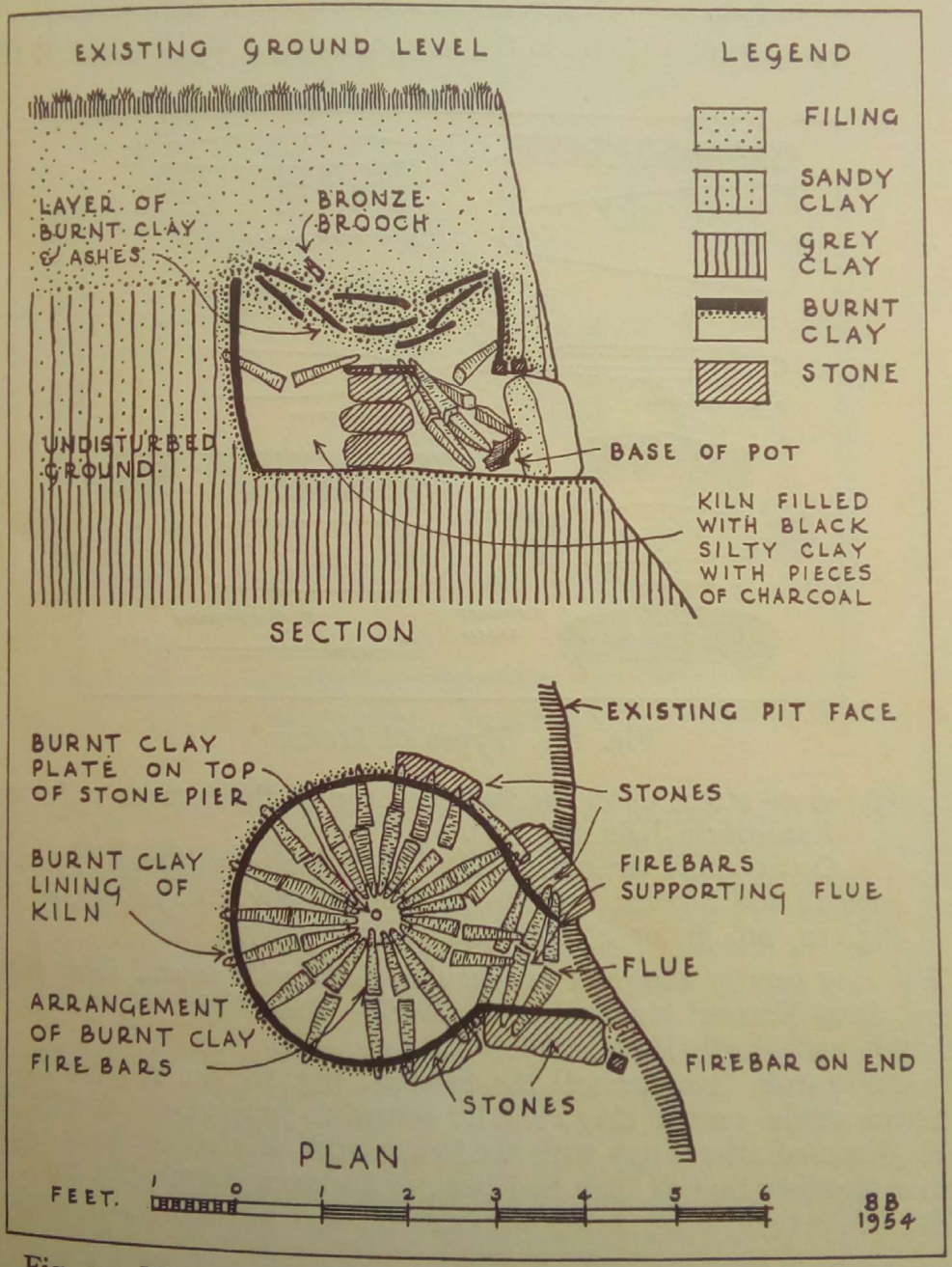

Fig. 9. Weston Favell, Northants. Plan and section of kiln

[1] *Antiq. Journ.* XXXIV (1954), 218 and fig. 1.

[2] Hayes and Whitley, *The Roman Pottery at Norton* (Roman Malton and District Report No. 7, 1950), Pls. IIa and Vb and fig. 8.

[3] Clarke, *A Roman Pottery at Earl Shilton* (1950), 2.

[4] *Op. cit.*, fig. 9.

[5] *Wilts. Arch. Mag.*, XXVII, 295.

[6] Information from the excavator, Mr. R. R. Clarke, F.S.A.

[7] Corder, *A Romano-British Pottery Kiln on the Lincoln Racecourse* (1949), 7 and Pl. IIIa, c.

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All such temporary supports had the obvious advantage over permanent structures of allowing the furnace and flue to be easily cleared of ash between the firings.

The following types of fire-bar, or sectional oven floors, have been recorded:

(*a*) *Thin vent-holed tiles of triangular shape* that fitted closely together to form a continuous floor, as at Sibson (Northants)[1] (1844), (fig. 8).

(*b*) *Clay bars, either flat or tapering or cigar-shaped* (fig. 10), one end of which rested on the central support and the other either:

(1) in a series of prepared holes in its sides, as at Upper Sheringham[2] (Norfolk) and Weston Favell[3] (Northants), (fig. 9), *or*

(2) on a prepared ledge in the furnace wall, as at Hedenham[4] (Norfolk), *or*

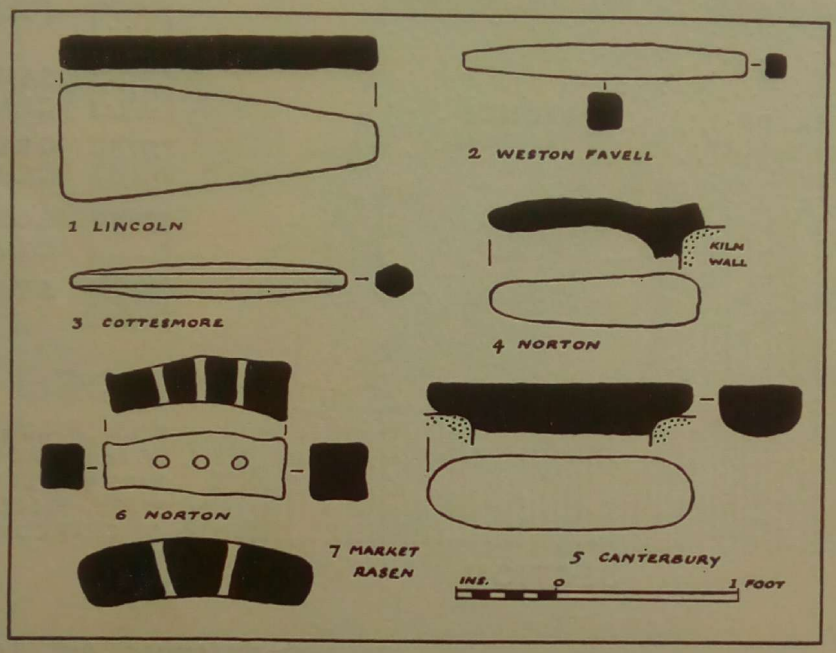

Fig. 10. Types of fire-bar

(3) more often, upon the flattened top of the furnace wall, as at Lincoln Racecourse Kiln (fig. 11).

Occasionally the outer end of the fire-bar was shaped so as to clasp the edge of the furnace wall, as at Norton[5] (fig. 10, no. 4), or Canterbury[6] (fig. 10, no. 5), or Stibbington, Kiln I (1957).

(*c*) *Thick clay bars of elongated rectangular shape with several holes pierced through them*, as at Norton[7] (fig. 10, no. 6), Market Rasen[8] (fig. 10, no. 7), West Stow Heath[9], and North Hykeham[10].

At Lincoln Racecourse[11] the fire-bars (fig. 10, no. 1) were of two lengths. The rim of the central clay cylinder served to support the shorter bars. These were disposed alternately with the longer ones, so that the bars could be placed closer together than if they had been of the same length (fig. 11). At Cantley, Kiln XX[12] there were seven fire-bars of oval section, which varied in length

[1] *loc. cit.*
[2] Information from the excavator, Mr. R. R. Clarke, F.S.A.
[3] *Loc. cit.*, 220 and fig. 1.
[4] *Norfolk Arch.* VI (1864), 149.
[5] *Op. cit.*, Pl. V*b*, 4: and fig. 9.
[6] Information from the excavator, Mr. Frank Jenkins, F.S.A.
[7] *Op. cit.*, Pl. V*a* and fig. 8.
[8] *The De Astonian*, no. 106, vol. 8 (1941), 26–27 (figs.). *J.R.S.*, XXXII (1942), 110, fig. 11 and Pl. VIII, 2.
[9] *J.B.A.A.*, XXXVII (1881), 152.
[10] *Antiq. Journ.*, XXXVIII (1958), 18 and Pl. VI*b*.
[11] *Op. cit.*, fig. 2 and 8–9.
[12] *Y.A.J.*, XXXVIII (1955), 541 ff.

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with the distance between the central pedestal and the kiln wall, the outer ends, as at Weston Favell, resting upon a depression in the kiln wall. At a recently excavated kiln at Canterbury, of which the excavator, Mr. Frank Jenkins, F.S.A., has kindly informed me, the radial fire-bars are recessed or slotted at

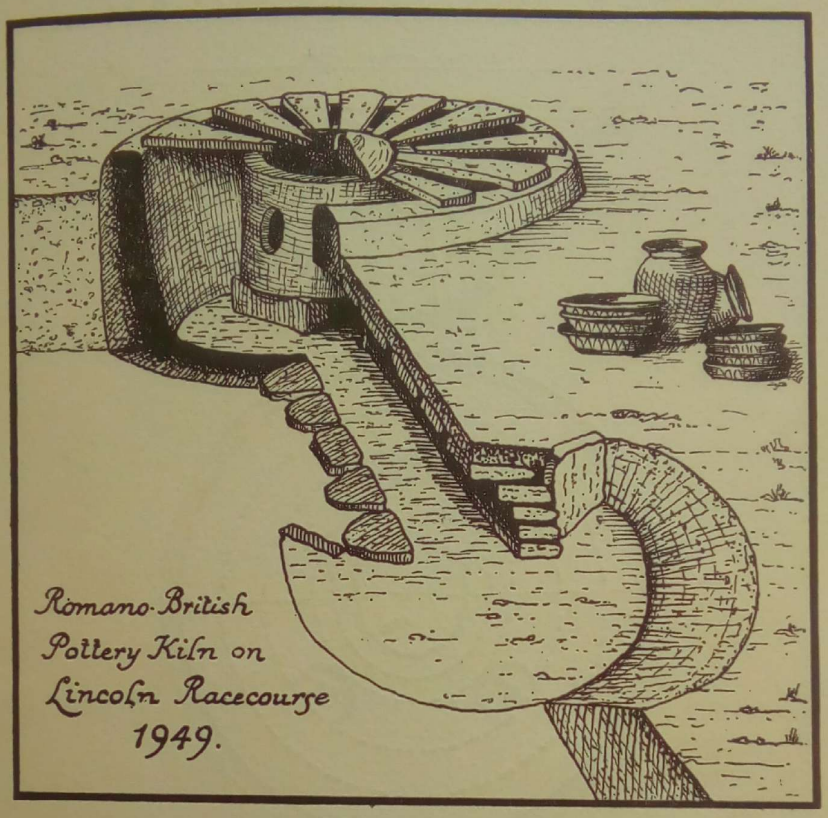

Fig. 11. Lincoln Racecourse. Reconstruction drawing of kiln

both ends to fit over the central support and the furnace walls (Pl. IIIB and fig. 10, no. 5). The use of radial clay fire-bars as an oven floor allows an even circulation of heat in the oven, but involves the problem of filling the gaps between them. This was sometimes overcome by packing between them broken potsherds, which are frequently found in the furnace, showing evidence of having been fired more than once.

There remain a certain number of kilns where a temporary oven floor, perhaps of fire-bars, must have been used, that yet had no central support. It has been noted above that some kilns have a series of pilasters around their furnace walls, partly no doubt, to increase the turbulence of the hot gases. In the Horningsea kilns[1], which are abnormal in being shaped like an inverted cone with the flue entering at the bottom, such projecting pilasters, either singly or in pairs, are flattened at the top and clearly must have supported some form of temporary floor (fig. 12). Though no fragments of fire-bars were recorded from the site, it must be concluded that they had been used, or the flat tops of the pilasters are difficult to explain. Moreover, there is no flat area on the furnace floor of these kilns on which a temporary central support could have been placed.

[1] Rev. F. G. Walker, 'Roman Pottery Kilns at Horningsea', *Proc. Camb. Antiq. Soc.*, LXIV (1913) *passim*.

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C. *TEMPORARY FLOORS WITHOUT EITHER FIRE-BARS OR OTHER FURNITURE*

A group of Suffolk kilns[1], with an outlier at Winterton (Lincs)[2] (Pl. IIIA), differ from the foregoing in not having an oven floor in the usual sense. They are characterized by having a very large circular central pedestal, as a permanent feature of the kiln structure, that widens out at the top like a mushroom or bollard with a flat top. The

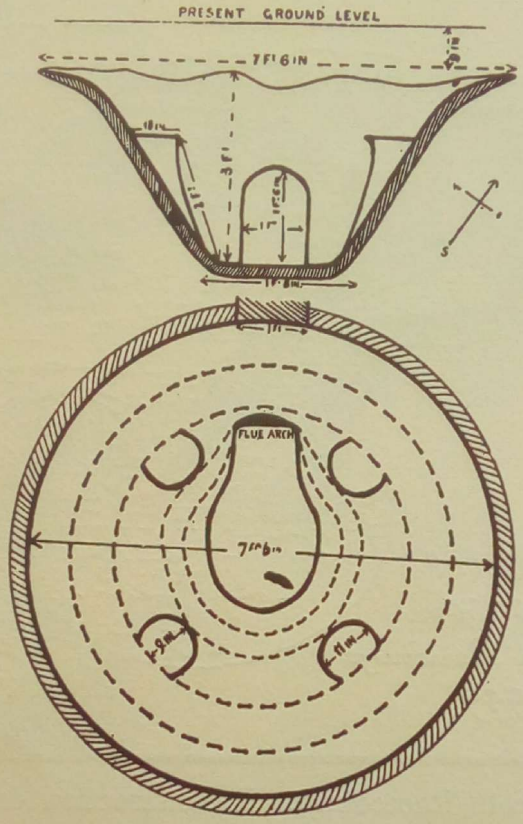

Fig. 12. Horningsea, Cambs. Kiln V, plan and section

best example is that from Foxledge Common, Wattisfield, which has been reconstructed in the Ipswich Museum[3]. In this the top of the pedestal is 2 ft. 3 ins. in diameter, leaving a circular space or flue less than a foot wide between its rounded upper edge and the kiln walls. In the Winterton kiln the central pedestal occupied an even larger part of the furnace (Pl. IIIA). This group resembles the inverted cone type (p. 16), except that it never has a vent-holed oven floor. How such kilns were worked has recently been shown by Miss M. Bimson, F.S.A., and Mr. F. J. Watson[4], who constructed a scale model of the Wattisfield kiln and fired in it replicas of Roman pots from the original kiln. The larger 'green' pots were used to bridge the gap between the pedestal and the kiln wall and in effect acted as a substitute for fire-bars. Once the gap was filled in this manner the pots were stacked upon the flat top of the pedestal, but not in the inverted piles that have been noted elsewhere.

At Winterton there was a shallow groove around the kiln wall at the level of the pedestal top (Pl. IIIA), and a temporary floor was built of potsherds and clay using this

[1] Wattisfield, *Proc. Suffolk Inst. Arch.*, XXII (1934–36), 178. West Stow Heath, *J.B.A.A.*, XXXVII (1881), 152. *Proc. Suffolk Inst. Arch.*, XXVI (1952), 145.

[2] Winterton, *The Reliquary*, vol. 9 (1868–69), 145.

[3] *Loc. cit.*, Pl. I.

[4] An account of the experiment was given to the Council for British Archaeology on 11th January, 1957, and a fuller illustrated account to the Society of Antiquaries on 24th October, 1957. I am indebted to Miss M. Bimson, F.S.A., for permission to summarize some of their results in this paper in advance of their fuller publication.

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as a support for its outer edges. Here, however, the kiln walls were carried up a further 1 ft. 5 ins. above the level of this temporary floor[1]. At Wattisfield it was found, experimentally, that the temporary oven roof could be made flatter than appears to have been normal in updraught kilns.

In some of the kilns found at West Stow Heath various types of kiln furniture were, however, found. In the two excavated by Mr. H. Prigg in 1878[2] he records a 'keystone-shaped brick or thick tile, of small size, perforated centrally' and several bricks, 13 ins. long, 8 ins. wide and 3 ins. thick, perforated with two holes 2½ ins. in diameter, and several 'roundels' of moulded brick, 6½ ins. in diameter and from 3 to 4 ins. thick. Mr. S. E. West, more than 70 years later, records rectangular bricks, 8¾ ins. long, and tapering 'fire-bars' 7½–8½ ins. long, as well as small cylindrical bricks[3]. It seems probable, therefore, that some system of fire-bars was sometimes used for bridging the gap between pedestal and kiln walls instead of the method described above (p. 22). It might be thought that so large a central support would prevent an even firing of the pots, but this was found in practice not to be so, for a variation of temperature of as much as 250° C in different parts of the oven did not result in cracking or distortion of the pots during firing, provided that the heating was not too violent in its initial stages.

One of the kilns found at Boar's Hill, Oxford, in 1953[4] (Pl. IVA), has neither permanent oven floor nor fire-bars, but a slightly raised circular platform on the furnace floor, much lower than the pedestals of the Wattisfield type. When found the kiln was packed full of pots from the last firing. If these had been placed on the low central platform, allowing a circular 'flue' space around it, the kiln could presumably have been operated in the same manner as those of the Wattisfield group.

II. HORIZONTAL-DRAUGHT KILNS (fig. 13)

This type of kiln is uncommon, and appears, so far as present knowledge goes, to be confined in the main to the Farnham district. In general form such kilns consist of clay-lined or stone-built tunnels which widen out in the middle to form the oven in which the pots were fired. The only examples so far scientifically examined and adequately published are the three kilns at Overwey, Tilford, excavated by Mr. Anthony J. Clark in 1947–48[5] (Pl. IVB). A kiln of the same type was found in 1906 about a mile south-east of Farnham[6]. It differed from the Overwey kilns only in having the two flues set at an angle of 156° instead of being set opposite one another. Another kiln at Snailslynch Farm was dug by Major A. G. Wade in 1926[7]. This is described as having one flue triangular in section, clay-lined, while the other was roofed with a large tile, and no stokehole pits are recorded. The central ovens of all these kilns had carefully laid level floors, and there can be no doubt that the pots were fired in them without any superimposed chamber such as is found in updraught kilns. At Snailslynch, and probably also at the Tilford Road kiln of 1906, the oven was still loaded, the pots being fired in piles inverted one upon another. At Snailslynch the triangular flue was said to have terminated in a vertical chimney, but the section illustrated in the published account, showing this passing through humus to the modern surface, is obviously an imaginary reconstruction and does not accord with the verbal description[8]. The method of operation of such kilns is aptly described by Mr. Falkner, the excavator of the 1906 kiln, in a passage worth quoting:

[1] These details are shown on a contemporary drawing to 1/6th scale preserved at the Society of Antiquaries: *see also* Dudley, *Early Days in North-West Lincolnshire* (1949), 137–138, which quotes a contemporary account from the *Lincolnshire Chronicle* of 28th August, 1868, and includes a contemporary photograph, fig. 51, here reproduced on Pl. IIIa by kind permission of the author.

[2] *J.B.A.A.*, XXXVII (1881), 152.

[3] *Proc. Suffolk Inst. Arch.*, XXVI (1952), 41.

[4] Unpublished. Information kindly supplied by the excavator, Miss E. Rutter.

[5] A. J. Clark, 'The Fourth-century Romano-British Pottery Kilns at Overwey, Tilford', *Surrey A.C.* LI (1949), 29–56.

[6] *Surrey A.C.*, XX (1907), 231.

[7] *Antiq. Journ.*, VIII (1928), 48–53.

[8] *Ibid.*, fig. 1, 49.

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"I am informed by a potter that such rude kilns were in use on a large scale in this part of the country until recent times, and that the dome was demolished between each baking. That is to say that the pottery was placed on the floor of the kiln, charcoal built up round and between it, and the whole covered with heather and clay and burnt, more fuel being fired in the flues[1]".

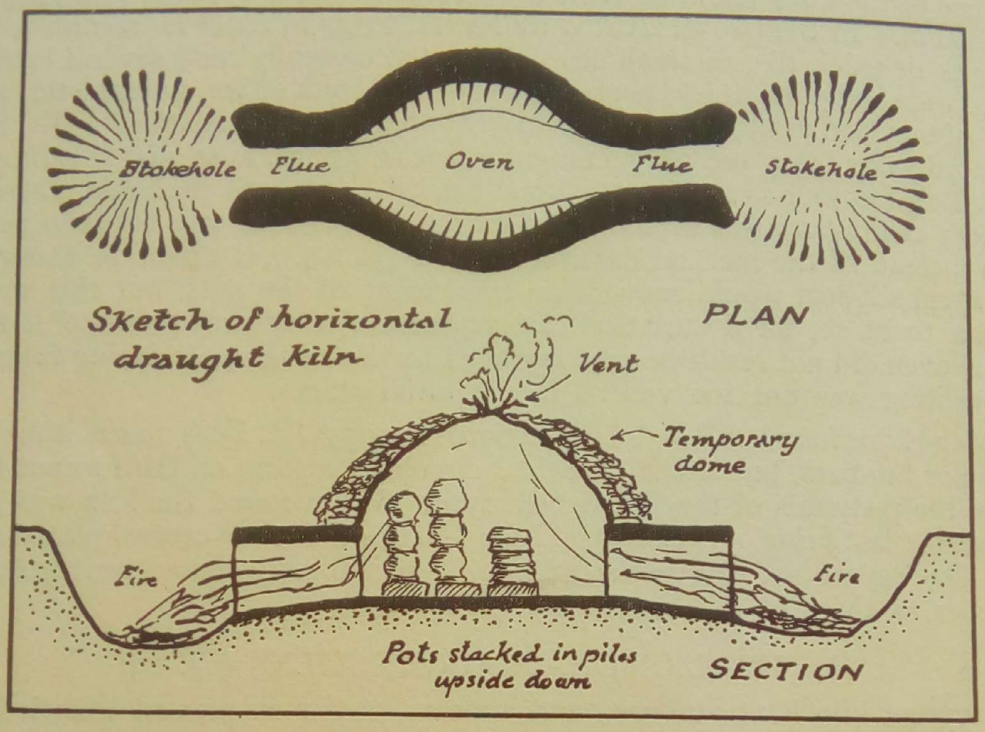

Fig. 13. A typical horizontal-draught kiln. Sketch plan and section

This accords well with Mr. Clark's conclusion; indeed, the finding of clay 'plates' covered with impressions of straw at his Overwey kilns supports this view[2]. Mr. Clark came to the conclusion that both stokeholes were in use at the same time, the required draught being obtained through an aperture in the top of the central dome of the oven. The finding of a large potsherd blocking one of the flues both at Snailslynch and at the 1906 kiln suggests that once the fire had burnt red in the oven the draught was stopped in this manner, the kiln sealed off, and allowed to cool slowly.

None of the other kilns that has been excavated in the same area has been adequately recorded[3]. In a district where pottery manufacture was so widely practised, the complete excavation of further kilns is urgently needed. One of the two Boars Hill kilns[4] appears to have belonged to the horizontal-draught group. In plan it resembles the Farnham type, but the central chamber, instead of having a flat floor, had a slightly raised circular platform in the centre[5] on which the pots were presumably stacked, allowing free circulation of heat between them and the oven walls.

THE GROUPING OF KILNS

In a great establishment like that at Holt, the tile and pottery kilns were grouped, as in modern brick-works, in a single plant or battery of kilns, three tile kilns and three pottery kilns being arranged in a row, with another pottery kiln lying at the back (fig. 1). Nothing comparable with this has been found elsewhere in Britain. Kilns are often found in close proximity to one another forming a veritable potters' field, as might be expected

[1] *Loc. cit.*, and *V.C.H. Surrey*, IV, 363 (fig.).
[2] *Loc. cit.*, 43.
[3] Whitmead (1893), *Surrey A.C.*, XII (1895), 151.
[4] Unpublished. Information kindly supplied by the excavator, Miss E. Rutter.
[5] *Cf.* Pl. IVA.

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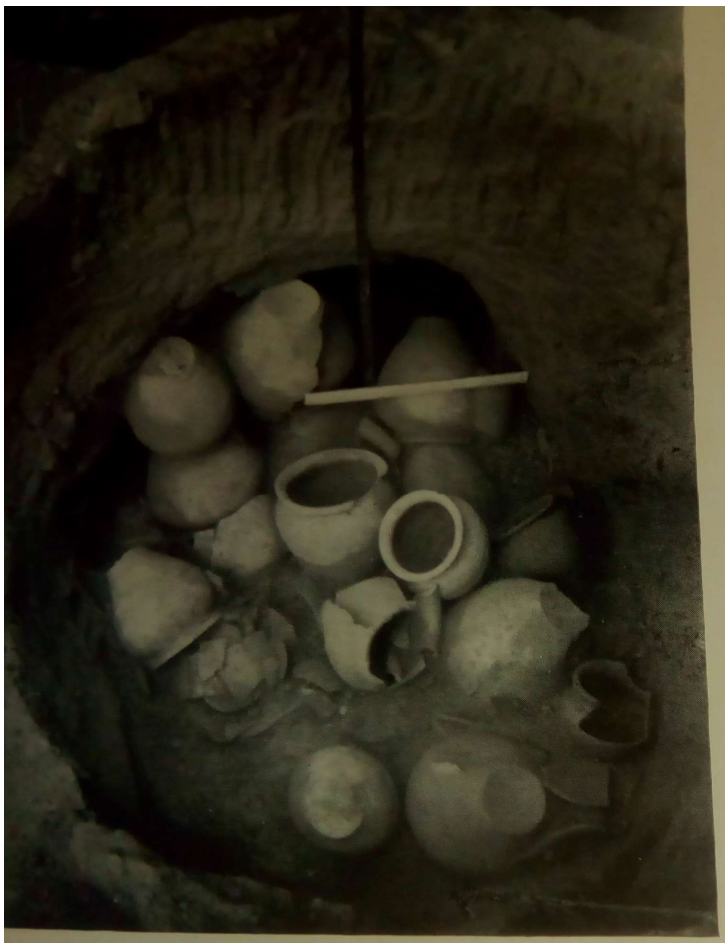

A. Boar's Hill, Oxford, 1953
(By courtesy of Miss E. Rutter)

B. Overwey, Tilford, Kiln I
(By courtesy of Mr. A. J. Clark)

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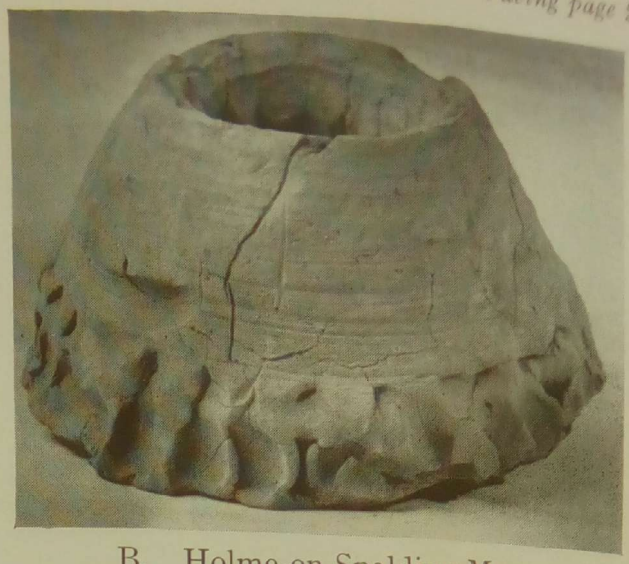
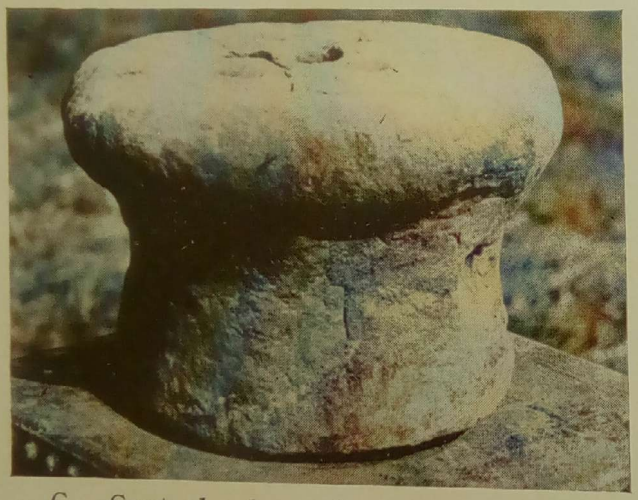
A. Crambeck



B. Holme-on-Spalding Moor
(*By courtesy of the Yorkshire Museum*)

CYLINDRICAL KILN SUPPORTS



C. Central column from Earl Shilton
(*By courtesy of the Leicester Museums*)

D. Kiln pads used in stacking mortaria at Holt
(*By courtesy of Hon. Sec. of Cymmrodorion*)

E. Clay plates from Norton, E. Yorks.
(*By courtesy of Mr. R. H. Hayes*)

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where considerable production was taking place, as at Colchester[1], Caistor[2], Alice Holt[3], Cantley[4] and Norton, but arrangement was haphazard. When a kiln wore out it was quickly filled up in the interests of traffic and replaced by a new one not far away, since any small kiln could be constructed in a few hours. Sometimes it happened that the site of an old kiln had been so far forgotten that a new one was cut through its filling (Norton)[5], or a new kiln was sited deliberately upon an earlier one, using it as a ready-made foundation (Throlam[6] and Cantley[7]). Generally, however, kilns are isolated structures. Only four types of grouping, other than that of the Holt plant, have been recorded:

I. *Pairs radiating from the same stokehole.*

The arrangement is uncommon, having so far been recorded only at Silchester[8], Crambeck[9], Cantley[10], South Carlton[11], Stibbington (1957)[12], and perhaps at Throlam[13]. The angle between the flues varies from about 40° at South Carlton to 120° at Crambeck (1936), and even as much as about 135° at Stibbington (1957). Such an arrangement can therefore hardly be claimed to bear any relation to the prevailing wind. Two other pairs at Crambeck (1928) are at angles of 70° and 83° respectively, and the Silchester pair of 87°.

II. *Pairs directly opposite one another from a single stokehole*

Of this arrangement Caistor-by-Norwich Kilns II and III[14] are the only example recorded, apart from the Updraught-Kilns II and III at Overwey.

III. *Four kilns disposed cruciform around a single stokehole*

The group found by Sir Christopher Wren under St. Pauls in 1672[15] is the only one recorded (Pl. IIB).

IV. *Five kilns ranged in a semicircle*

Five kilns ranged in a semicircle are said to have been found at Pitt's Inclosure, New Forest, in the 19th century, but no further details, and no plans were published[16].

CHRONOLOGY

It remains to be asked whether, among the great variety of structural detail here described there can be found any chronological significance. Is it possible, for instance, to relate any particular type of kiln construction to a particular period of activity? So far as our knowledge goes at present the answer must be an emphatic 'no'. Certain regional fashions can indeed be detected: for example, the central 'bollard' characteristic of so many Suffolk kilns, or the through-draught kilns of the Farnham district, but of evolutionary development there is no sign whatever. It must suffice to point to the great structural variety of the Cantley kilns where over 30 have been examined in one potters' field. Here in close proximity are kilns in pairs (nos. 1 and 2, and 4 and 6),[17] and single kilns; a furnace with a single flat central pilaster and no fire-bars (no. 25)[18], near a kiln with an elongated pedestal and plain radial clay fire-bars (no. 20)[19]; and, close to

[1] M. R. Hull, Soc. Ant. Research Report (forthcoming).
[2] Artis, *Durobrivae* (1928). *V.C.H. Hunts*, vol. I. *V.C.H. Northants*, vol. I. *J.B.A.A.*, vol. II, 164 ff.
[3] Wade and Lowther, *Alice Holt Forest; its History and its Romano-British Potteries* (1949).
[4] *Y.A.J.*, XXXVIII and XXIX (1955–56). Full report forthcoming.
[5] *Ibid.*, 14, fig. 4.
[6] *Op. cit.* figs. 6, 7, 8.
[7] *Y.A.J.*, XXXVIII, 403, 407, 539; XXXIX, 32, 364.
[8] *Arch.*, LXII (1910); May, *Silchester Pottery*, 192 ff.
[9] *Op. cit.*, figs. 5, 22, 23. *Antiq. Journ.*, XVII (1937), Pl. LXXXVIII.
[10] *Y.A.J.*, XXXVIII (1955), 404 ff.
[11] *Antiq. Journ.*, XXIV (1944), Pl. XXXI.
[12] Information from the excavator, Mr. B. R. Hartley, F.S.A.
[13] *Op. cit.*, fig. 6.
[14] *J.R.S.*, XXII (1932), Pl. VI, 3.
[15] *R.C.H.M. Roman London*, 140. B. M. Sloane MSS. 958, fol. 105.
[16] *Arch. Journ.*, XXX (1873), 323.
[17] *Y.A.J.*, XXXVIII (1955), 404 ff.
[18] *Ibid.*, XXXIX (1956), 42 ff.
[19] *Ibid.*, XXXVIII (1955), 541 ff.

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this, a kiln with wedge-shaped perforated fire-bars (nos. 1 and 2), and one with two central supports (no. 3). It must be provisionally concluded that each potter, while conforming to the general type, set out to achieve the end he had in view in his own, often experimental, manner.

KILN FURNITURE OF BAKED CLAY OTHER THAN FIRE-BARS (Pls. V and VI)

The manufacture of Samian ware involved the use of clay pipes or tubes, plugs, and collars of various forms. Up to the time of writing, though moulds for Samian ware have been found at York[1], Pulborough[2] and Peterborough[3], Samian manufacture in Britain has only been proved at Colchester[4]. Elaborate kiln furniture, such as was there employed[5], is not to be expected in the small local kilns for the manufacture of coarse pottery which form the subject of this paper.

In addition to the fire-bars, which have already been discussed (p. 20), other forms of prefabricated kiln furniture are to be looked for:

1. *Saggars and kiln props* are required for enclosing and supporting a glazed vessel during the process of firing the glaze. But glazed ware was never manufactured in any quantity in Britain, and only at Holt has the process been recognized and studied[6].

2. *Clay plates, bearing impressions of grass or straw*, have already been mentioned (p. 14). These are very often reported in association with kilns, and were frequently used in the construction of temporary oven walls, as at Horningsea[7] and Norton[8] (Pl. VE). They served the same purpose as the discarded lids at the Silchester kiln[9] (Pl. VIA).

3. *Pierced circular clay plates.* In two kilns where prefabricated central supports were used with radial fire-bars[10], a single roughly-made circular clay plate, 9 ins. to 1 foot in diameter, has been found in the kiln. At Weston Favell[11] (fig. 9) it was placed on the central pedestal of stones to form a level surface for the inner end of the fire-bars. The central hole, about 1 in. in diameter, no doubt served the double purpose of allowing passage of heat and providing an easy means of manipulation when hot.

4. *Distance pieces or pads* in the form of 'sausages' of clay rolled in the hand are required for separating flanged bowls stacked upside down in piles for firing. The use of these in the manufacture of mortaria has been recorded at Holt[12] (Pl. VD) but sand was used for this purpose at the Technical College kiln in Lincoln[13] (Pl. VIc). Bun-shaped pads or supports were noted at Horningsea[14].

5. *Thick curved banana-shaped props*, 15 ins. long and about 6 ins. in diameter at the thicker end, were found at Norton Kiln III[15]. One of these *in situ* (Pl. VID) stood against the furnace wall, narrow end uppermost, and served both as a pilaster to increase the turbulence of the hot gases and as a support for the oven floor of fire-bars.

[1] *Handbook to the York Museum* (1891), 106. Home, *Roman York* (1924), Pl. opp. 102.
[2] *P.S.A.*, 2nd ser. XXIII (1910), fig. 5.
[3] Hull Museum. Found at Peterborough according to the late Thomas Sheppard, curator, who told the author that he had picked it up on a rockery.
[4] *Germania*, Jahrg. 18, heft 1 (1934).
[5] *Ibid.*, Abb. 4. *Antiq. Journ.*, XXXVI (1956), Pl. XIV*b*.
[6] Grimes, *Holt* (1930), 182–3, frontispiece and fig. 78.
[7] *Proc. Cambridge Antiq. Soc.*, no. LXIV (1913), fig. 9.
[8] *Op. cit.* Pl. V*c*.
[9] *Arch.*, LXII (1910), 327 f. Slide in the collection of the Soc. Ant.
[10] Corder, *A Romano-British Pottery Kiln on the Lincoln Racecourse* (Nottingham University, 1950), 9 and fig. 2. *Antiq. Journ.*, XXXIV (1954), 221 and Pl. XXIII.
[11] *Ibid.*, fig. 1.
[12] *Loc. cit.*, fig. 79 and p. 183.
[13] *The Lincolnshire Mag.*, vol. 3, no. 7.
[14] *Proc. Camb. Antiq. Soc.*, LXIV (1913), fig. 42, p. 52.
[15] Hayes and Whitley, *op. cit.*, 20, fig. 8 and Pl. V*b*.

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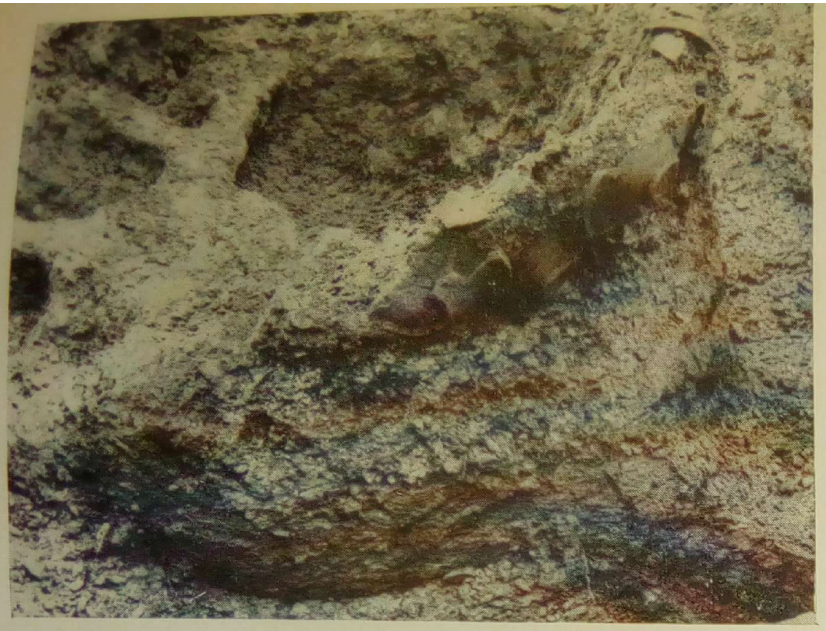
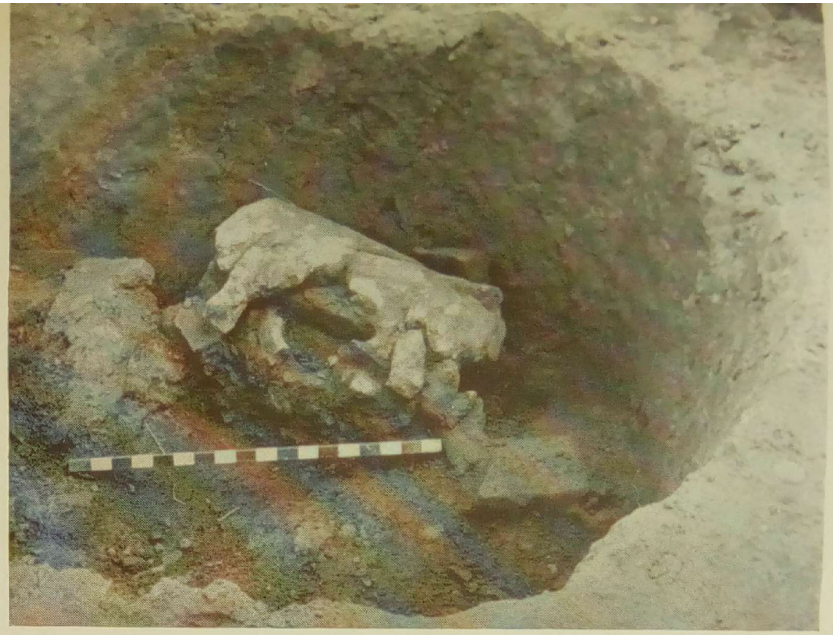


A. Wasters used to reinforce oven wall at Kiln I, Silchester
(*By courtesy of the Society of Antiquaries*)



B. Central support in the Lincoln Racecourse Kiln
(*By courtesy of Mr. A. Warhurst*)

C. Cylinder in the Technical College Kiln, Lincoln
(*By courtesy of the Lincolnshire Echo*)

D. Norton, E. Yorks. Kiln III with 'banana' kiln support *in situ* (*By courtesy of Mr. R. H. Hayes*)

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6. *Squat clay cylinders*, 7–10 ins. in external diameter and 3–4 ins. high, with a central hole 3–5 ins. in diameter, were found in some quantity at Crambeck[1] (Pl. VA). A similar cylinder of more pyramidal form from near the Throlam potteries at Holme-on-Spalding Moor is in the Yorkshire Museum[2] (Pl. VB). They were roughly turned on the wheel, and have flat bases showing the imprint of the potter's thumbs around the edge, resulting from the pressing of the lump of soft clay on to the wheel. It seems probable that these objects were distance pieces and supports used for separating piles of pots in the oven, the central aperture allowing even distribution of heat to the upper layers. Curved 'ring-supports' of rectangular section are recorded at Horningsea Kiln VII and at Earl Shilton. According to the Rev. F. G. Walker, the careful excavator of the former, these were used as supports in the same manner as the Crambeck cylinders.

7. *Central pillars of clay* must also be looked for where suitable stone or tile was not available. The 'mushroom' from Earl Shilton[3] is 10¼ ins. high and 14½ ins. in diameter at the top, pierced by three small diagonal holes (Pl. VC). That it formed a support for the inner ends of fire-bars is certain[4]. The holes are so small that they are more likely to have been made for easy manipulation than for allowing the free distribution of heat. The central cylinder at the Lincoln Racecourse kiln[5] is without a parallel at present. It had been built up from a series of 'sausages' of clay about 2 ins. in diameter, the whole then being smeared over with clay to form a more or less permanent structure (Pl. VIB). The lateral holes or 'windows' in its sides relate it to the squat cylinders, like miniature drain-pipes, that apparently supported the roof of the unusual rectangular kiln at the Lincoln Technical College[6] (Pl. VIC) in which the potter *VITALIS* made mortaria, for these cylinders also were pierced by lateral holes.

8. *Semicircular arches* of clay, specially made for roofing the flue, were found at the kiln at Corby (Northants) in 1902[7]. Elsewhere fire-bars were sometimes used for this purpose, as at Weston Favell (fig. 9), but slabs of stone are more usual, as at Crambeck (fig. 4).

No doubt many other types of makeshift prefabricated kiln furniture have gone unrecognized or are still to be identified by the careful study of the broken bric-à-brac surrounding ruined kilns. If we are to gain a better understanding of the working of these common but neglected structures, future excavators must be urged to look more carefully at their bits and pieces, and to exercise at least as much ingenuity in their interpretation as was given to their manufacture by the Romano-British potters.

ACKNOWLEDGMENTS

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[1] Corder, *The Roman Pottery at Crambeck, Castle Howard* (1928), 43 and fig. 18.
[2] Yorkshire Museum (unpublished).
[3] Clarke, *A Roman Pottery Kiln at Earl Shilton* (1950), fig., p. 2.
[4] *Ibid.*, fig., p. 5.
[5] *Op cit.*, 7–8 and Pl. IIIa, c.
[6] *Op. cit.*, Pl., p. 2. *J.R.S.*, XXVII (1937), 233, fig. 20.
[7] *Journ. Northants Nat. Hist. Soc. F.C.*, vol. XI, no. 92 (1902), frontispiece. The kiln is preserved in Abington Abbey Museum.

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